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RAIL REFRIGERATION TEST WITH FLORIDA CITRUS
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A broad study of the transit refrigeration requirements of Florida citrus fruits, requested by the Florida Citrus Exchange and the Growers and Shippers League of Florida, has been under way since the fall of 1948. During this period, three sets of transportation tests and approximately 600 shipping tests have been made. The Florida Citrus Commission cooperated financially in these tests, which were conducted in cooperation with numerous shipping and receiving agencies. The transportation tests were planned to cover 1) the moderately cold weather of late fall or early winter, 2) the transition season from cold to hot weather in mid-spring, and 3) the moderately hot weather of late spring. The objectives of these accompanied tests were twofold: 1) to gain information on the range of commodity temperatures at different locations in the car when given the protective services normally utilized at the different seasons; and 2) to supplement findings obtained from the large scale shipping (non-accompanied) tests - commercial in every respect - made during the past three seasons by means of a single recording thermometer placed at a representative location in each car. With concrete evidence at hand from the accompanied tests showing temperatures throughout the load during the transit period, the shipper can better evaluate the data from the shipping tests in which only one or two thermometers were used, and thereby more intelligently select the most efficient car and expedient protective service for any given condition. A report on the 600 non-accompanied shipping tests is in preparation and will follow the reports of the three transportation tests.

This report covers the first of the accompanied transportation tests which was made in late November, 1950. Comparisons were made of various protective services in common use with loads in fan and non-fan double deck cars, mesh bags over wirebound crates and solid loads of crates in the regular cars. Some deviation from the original plan was necessary at the last minute because of the cancellation of orders for two cars after they had been loaded and unseasonably cold weather during the first half of the trip. This subfreezing weather required some deviation in the services that involved changing to standard ventilation (keep vents closed below 32°) at both Savannah and Hamlet. As these low temperatures would require vents closed during this portion of the trip and so defeat one of the main objectives of the test, it was decided to open the vents and keep them open under special ventilation rules so long as there was no danger of freezing in the coldest part of the load. However, as air temperatures were down as low as 15° at Hamlet, only the diagonal vents were kept open until the temperature rose above 20°. The test, as finally made, consisted of 7 cars and these cars, their method of loading, and the protective service each received are listed in Table 1. The cars were loaded on November 24 in Orange and Lake Counties, Florida, and were assembled at Wildwood late that night. Routing was via the Seaboard Air Line; Richmond, Fredericksburg and Potomac; and Pennsylvania Railroads to the New York area.

METHODS

Standard procedure was followed in preparing and loading all of the test cars, which were the end bunker type. Twelve electrical resistance thermometers, suspended from the ceiling in the forward end of the car, were placed in predetermined locations along the centerline in each load and connected with a master cable that lead to the runningboard on top of the car. This outer end of the cable was so constructed that it could be plugged into a reading box thereby enabling the observer to note, at any time, the temperature at the 12 locations inside the car.

Two thermometers were used for car air and 10 for commodity temperatures. One of these air thermometers was placed in the air channel below the floor-rack at the bunker, the other about six inches below the ceiling, eighteen inches from the bunker. Fruit temperatures were taken by inserting the bulb of the thermometer into a fruit in the second layer in the crate separated by one fruit from the end and side of the crate. The crates containing the thermometers were placed in the bunker, quarterlength (half way between the bunker and doorway) and doorway stack of the load in the bottom, middle and top layers of crates. When the fruit was packed in consumer unit bags the thermometers were placed at the same relative location as was the case with fruit in crates. These were the standard positions used in each car and consisted of two air temperatures and nine fruit temperatures. The location of the twelth thermometer varied. In double deck loads it was used to show the temperature of fruit just beneath the pad-covered deck, usually at the quarterlength, since it was thought that air circulation might be retarded by the padding material and large temperature differences result thereby. In loads of Bruce boxes, the spare thermometer was placed in the center of a box to compare temperatures here with the outer second layer of fruit.

Inasmuch as test cars are usually loaded at different packing houses with fruit from different sources and of different quality, a direct comparison between cars is likely to be misleading in some respects. In order to have comparable fruit in each car for test purposes, a package of fruit of the same characteristics, from the same grove, was placed at the same location in each car. This test fruit was of medium size, U. S. No. 1 Grade. These test packages were examined critically at unloading and were held for one week at room temperatures when a final inspection was made.

The double deck cars were loaded with 7,168 5-pound open mesh bags. Two of the regular cars received a standard 525 box load of 1-3/5 bushel wirebound crates, while the third had 3,680 5-pound mesh bags over 210 1-3/5 bushel crates. Car F was precooled by means of its Preco fans for six hours at the loading point.

During the loading period commodity temperatures were taken with a fruit thermometer as the fruit was trucked into the car. A temperature reading was made with the resistance thermometers as soon as possible after completion of loading, and subsequent readings were made as frequently as circumstances permitted during the transit period.

RESULTS

Inasmuch as weather conditions during any transit period are an important consideration in the interpretation of results, a brief review of the outside air temperatures encountered during this transit period, is especially desirable, since the test cars were subjected to abnormal temperatures during the first and second day after loading. On the day of loading, the maximum outside air temperatures were in the 70's followed by a sudden, unseasonable drop during the night with sub-freezing temperatures encountered throughout the following day and the second night after loading. The morning after loading, the temperature in North Central and North Florida was about 20 degrees below normal and from 20 to 25 degrees below normal along the route through Georgia and the Carolinas, gradually rising to about 5 degrees below normal when the test cars reached the Jersey City area.

Average Commodity Temperatures En Route

The average temperatures arrived at by averaging three positions in each of the three levels in each car shown in figure 1, Table 2, reveal some interesting facts. During loading the average commodity temperature in the separate cars, ranged from 71.0° to 84.0°. At Savannah, the afternoon of the next day, the range was from 57.6° to 61.6° except in the precooled car which was 51.1°. North of Savannah, the most precipitous cooling occurred in the ventilated cars, the most rapid occurring in the one vented at Savannah. At Hamlet the next morning, the range was from 50.1° to 55.3° in the non-precooled and non-vented cars. In the precooled car, the commodity temperature averaged 45.7° and in the car vented at Savannah, it was 36.6°, representing an overnight reduction in commodity temperatures of 5.4 degrees in the precooled load in a fan car, and 23.5 degrees in the car with vents opened at Savannah. When the temperatures were recorded at Jersey City some 36 to 40 hours later, the range in all cars was from 38.6° to 44.9°, thus showing that the car vented at Savannah had a cooler load at Hamlet the next morning than was found in any car on arrival at Jersey City.

Re-icing at Hamlet and vents kept closed to destination did not result in cooling the load as rapidly as did only initial icing followed by ventilation beyond Hamlet.

The precooled load in a fan car was 7.3 degrees cooler than a comparable non-precooled load at Wildwood, whereas at Savannah, the precooled load was 7.6 degrees cooler, and at Hamlet 8.0 degrees cooler. At destination, the non-precooled load was 1.1 degrees cooler than the precooled load. The precooled load had a 12 to 15 hour advantage in temperature reduction over a similar, but non-precooled load. This time lag was maintained until reaching Hamlet where the non-precooled car was re-iced. Thereafter, the lag diminished, and had vanished when the test cars arrived at Potomac Yards where the average temperatures in the two cars were practically identical.

A more detailed accounting of the average temperatures in the bottom, middle, and top of the load separately during transit, together with that of ice meltage, follows.

Ice Meltage

Ice meltage, Table 3, was greater in the cars that were re-iced en route and the vents kept closed to destination, than that in the non-re-iced cars with vents opened. This difference was probably due, in part at least, to the low outside air temperature; low enough to aid greatly in cooling the load without melting much ice.

In the vented, but not re-iced cars, the bunkers had from 1,000 pounds to 5,000 pounds of ice, Table 3, at destination, the least in the fan car G, loaded with mesh bags over crates, and the most in the double deck car D, vented at Savannah.

The ice remaining at destination in the bunkers of the re-iced, but not ventilated cars ranged from 1,000 pounds in the precooled car F, to 6,400 pounds in the non-fan double deck car C, and fan car E.

The ice remaining in the bunkers on arrival at New York, ranged from 1,000 pounds to 3,100 pounds in the initially non-re-iced cars vented at Hamlet. This supply of ice aided by cool but nearly normal outside air temperatures, was sufficient to prevent a rise in commodity temperature during the five day holding period before the cars were unloaded.

The discussions based on averages may be misleading. This is particularly true when average temperatures in non-fan cars are compared with those in fan cars. For that reason a more detailed accounting by cars not only of ice meltage, but also of temperatures during transit is given.

Car A

A double deck car, figure 2 and Table 5, equipped with Preco fans under the floor racks, was loaded with oranges in mesh bags. This car was initially iced with 8,000 pounds at Wildwood after loading, the vents were kept closed to Hamlet, when diagonal vents were opened. On arrival at Raleigh all vents were opened and kept open to Potomac Yards, there the car was converted to standard ventilation. The average commodity temperature during loading was 78.5°F. At Wildwood it was 75.7°, Savannah 59.0°, at Hamlet where the vents opened, 50.7°, Potomac Yards, 42.6°, and at Jersey City (Greenville Yards) three days after loading, the average commodity temperature was 41.6°. All parts of the load had fallen to 60° soon after reaching Savannah and to approximately 50° on arrival at Raleigh. The spread in temperature within the load was less than 5 degrees during the greater part of the trip, with the top fruit being coldest most of the time because of the car fans.

On arrival at Hamlet there remained approximately 2,400 of the 8,000 pounds of ice, Table 3, supplied at Wildwood. At Potomac Yards there were 1,400 pounds remaining, and 1,200 pounds of ice was left in the bunkers when they were inspected at destination at noon of the fourth day after loading, resulting in a total ice meltage of 6,800 pounds during the transit period. There was still a trace of ice in the bunkers when the car was unloaded December 4, nine days after loading.

Car B

This test, figure 3 and Table 6, differs from that in car A only in that car B was not equipped with fans. The average commodity temperature during loading was 73.1°F, at Wildwood it was 69.7°, at Savannah 61.6°, and at Hamlet where the vents were opened it was 55.3°. At Potomac Yards, the average temperature was 41.2°, and at Jersey City (Greenville Yards) three days after loading, the average commodity temperature was 42.8°.

There was a wide range in commodity temperature, at times as much as 20 degrees, in this car throughout the transit and holding period. At all times the bottom layer was the coldest part of the load. During the transit period, except at Raleigh, the top of the load was but a few degrees warmer than the middle layer, whereas the bottom layer was considerably colder. On arrival at Jersey City, the warmest part of the load was 49.1°F. and the coldest 35.4°. During the holding period with vents open, the spread lessened, and at unloading five days later, the bottom layer averaged approximately 34° and the top layer approximately 41°.

The warmest part of the load had not fallen to 60° when the car arrived at Hamlet, where only the diagonal vents were opened, during the early hours of the second day after loading. After opening the vents, the commodity temperature fell rapidly and the warmest part of the load reached 50° some 10 hours later when the car had reached Richmond.

From the 8,000 pounds of ice supplied at Wildwood, Table 3, there was approximately 4,800 pounds remaining when the bunkers were inspected at Hamlet, 4,000 pounds at Potomac Yards, 3,100 pounds at destination noon of the fourth day after loading and 2,400 pounds remained five days later when the car was unloaded. During this holding period of approximately normal outside air temperatures, the vents were kept open.

Thus, there was a total ice meltage of 4,900 pounds during the transit period and 700 pounds during the five day holding period.

Car C

This test, figure 4, and Table 7, differs from that in car B in that the bunkers of car C were replenished at Hamlet and the vents were kept closed to destination.

The average commodity temperature during loading was 84.0°F. At Wildwood the average temperature was 67.2°, at Savannah 59.9°, at Hamlet 52.5°, at Potomac Yards 47.2°, and on arrival at Jersey City (Greenville Yards) the third day after loading the average commodity temperature was 44.9°.

The spread in commodity temperature was from 15 to 20 degrees or more throughout most of the transit period, and not less than 6 degrees at the end of the holding period. Car C was a non-fan car. The bottom layer was the coldest part of the load at all times, and the top layer the warmest. The temperature reduction in the top and middle layers progressed at a fairly uniform rate. The top of the load was from 3 to 7 degrees warmer than the middle layer at all times except at Wildwood before the ice was supplied and vents closed. The warmest part of the load fell to 60°F. by noon of the second day after loading, somewhat north of Raleigh, but 50° was not reached until after the car had reached Jersey City. On arrival at Jersey City, the bottom of the load averaged 36.1° and the top 52.8°. At unloading five days later, the bottom of the load averaged about 34° and the top of the load about 41°, and the grand average was about 1 degree warmer than that of car B.

This car was initially iced with 9,600 pounds, Table 3. On arrival at Hamlet approximately 6,000 pounds remained and 3,600 pounds were supplied to replenish the bunkers. On arrival at Potomac Yards there was approximately 7,200 pounds of ice left and 6,400 pounds was left at Jersey City for a total ice meltage of 6,800 pounds during the transit period of four days. Five days later, when the car was unloaded, 3,200 pounds of ice remained. During this holding period, the vents were kept closed.

Car D

This test, figure 5, and Table 8, differed from that in car B only in that the vents were opened the evening before those of car B. At Savannah where the outside air temperature was 24°F., the vents of this car were opened to let in the cold night air. The following morning, on arrival at Hamlet where the outside air temperature was 15°, the diagonal vents were closed to retard the rate of cooling. At Raleigh about four hours later when the outside air temperature was 27°, these closed vents were reopened.

The commodity temperature during loading was 71°F. At Wildwood the average commodity temperature was 68°, at Savannah it was 60.1°, at Hamlet 36.6°, an overnight reduction in temperature of 23.5 degrees, at Potomac Yards it was 35.2°, and at Newark (Waverley) during unloading in the night of the third day after loading, the commodity temperature averaged 38.6°. The spread in commodity temperature in this non-fan car during the transit period was from 15 to 20 degrees until the afternoon of the second day after loading when it was reduced to about 10 degrees and remained at or near that level. The warmest part of the load reached 60° before the car passed Charleston, South Carolina, and seven hours later it was 50°. During the greater part of the transit period north of Savannah the middle layer was warmer than the top and the difference was greatest, as much as 18 degrees, at Hamlet. At Potomac Yards, the coldest part of the load averaged slightly below 30° and the warmest, the

middle, slightly above 40°. At unloading during the fourth night after loading the coldest layer averaged slightly below 30° and the warmest, the top, about 43°. The most rapid rate of cooling occurred between Savannah and Hamlet when all vents were open during the coldest part of the trip while the outside air temperature dropped from 24° to 15°. The night air was so effective in cooling the load that when Hamlet was reached the average temperature in the top of the load was less than 2 degrees warmer than the average of the bottom layer; at Hamlet the coldest location of the load, the bottom bunker position, was 27.7°; the bottom quarterlength was 27.8°. The coldest location in the top of the load was the top quarterlength position, 29.7°, whereas the coolest part of the middle layer, the middle bunker, was 43.9°. After fruit temperature records were made at Hamlet, it was decided to lessen the flow of air through the car by closing the diagonal vents, thereby avoiding further cooling of the commodity in the coldest locations. They were left closed about four hours until the outside air temperature had risen to 27°, when they were opened again at Raleigh. During this four hour period there was little change in commodity temperature in the coldest locations. Although these low commodity temperatures approached the danger point, no freezing injury was detected in the fruit at unloading.

This car was initially iced with 9,600 pounds, Table 3. At Hamlet there was approximately 8,000 pounds of ice remaining; at Potomac Yards, 5,800 pounds; and at Newark, when the car was unloaded, slightly less than three days after icing, 5,000 pounds of ice remained. Thus, approximately 4,600 pounds of ice was melted during the transit period.

Car E

This test, figure 6A and Table 9, was with crated oranges loaded in a pre-iced fan car, re-iced only once, at Hamlet, and the vents were kept closed to destination.

The average commodity temperature at loading was 77.5°F. At Wildwood it was 67.9°; at Savannah 58.7°; at Hamlet 53.7°; at Potomac Yards 43.0°; and at unloading in New York City, the fourth night after loading, the average commodity temperature was 40.2°.

After the car left Wildwood the spread in temperature within the load ranged from 5 to 7 degrees. The top of the load was cooler than the middle or bottom from Baldwin north, whereas the temperatures in the middle and top crates ran closely parallel from that point to destination.

The warmest part of the load reached 60°F. somewhat north of Savannah during early evening of the day following loading and 50° was reached about 18 hours later when the train was in Southern Virginia, and 45° at Potomac Yards. During the next 24 hours the temperature in the warmest part of the load was reduced only 3 or 4 degrees with about 1 degree reduction in the top of the load. At unloading the coldest layer averaged approximately 38° and the warmest 42°.

This car, Table 3, was pre-iced with 9,600 pounds. On arrival at Hamlet only 1,200 pounds of ice remained, there the bunkers were replenished with 8,400 pounds. On arrival at Potomac Yards, 7,200 pounds of ice remained in the bunkers whereas at New York, about 24 hours later or three and a half days after loading, 6,400 pounds of ice was left. Thus, during this three and a half days transit period there was a total ice meltage of 11,600 pounds.

Car F

Car F, with crated oranges in a pre-iced car, was precooled six hours with Preco fans at loading point, and the bunkers were replenished at Wildwood, the first icing station reached en route.

The rate at which these warm oranges were precooled is shown in figure 7 and Table 10. The average temperature of the fruit was 81.5°F. as it entered the car. Loading extended over a period of approximately four hours during which time the car fans were not operating and the fruit in the bottom layer of boxes cooled 12 degrees whereas that in the top and middle layers cooled less than 2 degrees.

At the end of the first hour of precooling the delivery air was 49.5°F. and was 20.8 degrees cooler than the return air; at the end of the sixth hour the delivery air had risen a few degrees to 53° and was only 13.3 degrees colder than the return air, due in part at least to less ice surface to cool the air. During the six-hour precooling period the bottom of the load which had cooled 12 degrees during loading cooled only 1.8 degrees whereas the middle and top layers lost 15.8 and 22.7 degrees, respectively, resulting in an average temperature reduction for the car of 13.4 degrees.

At the end of the precooling period, there was a spread in temperature of 9.6 degrees between the top and bottom layers of crates, i.e., coolest and warmest layers. The fan levers were then placed at the "on" position prior to moving the car to Wildwood. About nine and one-half hours later this car reached Wildwood, 22 miles distant, where the bunkers were replenished with 8,500 pounds. By that time, due to slow car and fan movement, the temperature in the top layer of crates had risen 0.7 degrees, and 1 degree in the middle crate whereas the bottom layer had cooled about 9 degrees, to approximately the same level as that of the top layer. During the interval between loading and arrival at Wildwood, the average temperature of the load had cooled from 81.5°F., to 60.6°, a reduction of 20.9 degrees. By the time the car reached Savannah, figure 6B, Table 11, its average temperature was 51.1°; at Hamlet 45.7°; at Potomac Yards 42.6°; and at New York City, the third night after loading, the commodity temperature averaged 41.3°.

During the transit period, there was a spread in commodity temperature as high as 9 degrees between the coldest and the warmest parts of the load. The top layer, due to fan action during precooling and in transit was the coldest throughout the transit period with the bottom layer the warmest during most of that period. The warmest layer (middle, temporarily) did not reach 60°F. until mid-morning of the day after loading before the car reached Baldwin,

whereas an average of 50° in the warmest layer (bottom) was not reached until soon after the second midnight after loading. Thereafter, all parts of the load were in the 40's. At unloading, during the fourth night after loading, the bottom and middle layers, the warmest parts of the load, were about 42°.

This car was pre-iced with 9,600 pounds, Table 3, and the bunkers were replenished at Wildwood with 8,500 pounds. At Potomac Yards, 1,900 pounds of ice remained whereas at unloading three and a half days after loading, 1,000 pounds was unmelted from the 18,100 pounds of ice supplied, making a total ice meltage of 17,100 pounds.

Car G

This test in a fan car loaded with oranges in open mesh bags over two layers of wirebound crates, figure 8 and Table 12, was initially iced after loading. The vents were kept closed from Wildwood until Hamlet was reached about 25 hours later. There, because of the low outside air temperature, only diagonal vents were opened and at Raleigh, some four hours later, all vents were opened and kept open until reaching Potomac Yards, where the car was changed to standard ventilation service.

The average commodity temperature was 78.3°F. during loading. On arrival at Wildwood it was 71.4°; at Savannah 57.6°; at Hamlet 50.1°; and at Potomac Yards 39.2°. On arrival at Jersey City (Greenville Yards) the afternoon of the third day after loading, the commodity temperatures averaged 39.2°. This car was held five days at Harlem River before unloading and at no time did the average commodity temperature rise above 38.2°.

The top layer was the coldest part of the load, and the bottom layer was 1 or 2 degrees warmer than the middle layer during most of the transit period.

The spread in temperature between the coldest and warmest fruit was about 10 degrees during the day after loading, becoming less as the trip continued. On arrival at Potomac Yards, the spread was 5 degrees or less and continued to diminish.

The warmest part of the load reached 60°F. during the evening of the day after loading soon after leaving Savannah, whereas 50° was reached slightly north of Raleigh, the second morning after loading, and below 40° during early afternoon of the third day after loading. During the holding period, there was not much change in commodity temperature. At unloading, six days after reaching the New York area, the commodity temperature ranged between 36.0° and 40.0°.

This car was supplied with 8,000 pounds of ice, Table 3, after loading. On arrival at Hamlet 2,400 pounds remained; at Potomac Yards 1,900 pounds; and at New York City, four days after loading, 1,000 pounds remained, resulting in a total ice meltage of 7,000 pounds. At unloading, six days later, there was still a trace of ice in the bunkers.

SUMMARIZED COMPARISON OF TEMPERATURES IN TRANSIT

BETWEEN CARS USED IN TEST

Comparison of Protective Services

Cars A and B provided a comparison of fan and non-fan double deck cars, loaded with oranges. The test clearly showed the advantages to be derived from the use of fans. Although the average temperatures in the two cars were about the same there was much wider spread between maximum and minimum commodity temperatures in non-fan car B than in fan car A, when the vents were closed, i.e., south of Hamlet, with vents opened, the spread was reduced.

Cars B and C were non-fan double deck cars loaded with oranges in open mesh bags. Car B was not re-iced in transit, but was vented at Hamlet, whereas car C was re-iced at Hamlet and the vents were kept closed to destination. There was practically no difference in temperatures in these cars as far north as Hamlet. Immediately beyond that point, temperature reduction was more rapid in the top and middle layers in car B, thus indicating that ventilation north of Hamlet under weather conditions such as prevailed during this test, resulted in more rapid cooling than did replenishing the bunkers with ice and keeping the vents closed to destination.

Cars B and D. These double deck cars, loaded with open mesh bags were initially iced and varied only in ventilation. Car D was vented at Savannah, whereas car B was run to Hamlet before vents were opened. Both cars received the same service thereafter. The reduction in average fruit temperatures was about the same for both cars as far as Savannah, but after opening the vents on car D, its temperatures dropped sharply, the average being 18.7 degrees lower than car B upon arrival at Hamlet. With both cars being handled the same thereafter, temperatures were more nearly the same upon arrival at destination. Total ice meltage was about the same but car D used much less ice to Hamlet because of the open vents from Savannah to Hamlet in sub-freezing weather.

Cars C and D, both non-fan double deck cars, were also loaded with oranges in open mesh bags. The former was re-iced at Hamlet and its vents were kept closed to destination, whereas the latter car was not re-iced but converted to ventilation at Savannah. Temperature reduction in these two cars were almost identical as far as Savannah. Beyond that point the commodity in car D cooled much more rapidly than that in car C. The top of the load in car C cooled 5.3 degrees during the night between Savannah and Hamlet while that in vented car D cooled 36 degrees. When unloaded, the warmest part of re-iced car D was about 8 degrees cooler than the warmest part of the load in car C which was not re-iced.

Cars E and F afforded a comparison of crated oranges in pre-iced cars equipped with Preco fans kept "on" during the transit period. The load in car E was not precooled but was re-iced at Hamlet. Car F was precooled with the car fans for six hours at the shipping point, and was re-iced at Wildwood. When the cars left Wildwood the non-precooled load was 7.3 degrees warmer than

the precooled load. It required 12 to 18 hours for the non-precooled load, car E re-iced at Hamlet, to become as cool as the precooled load was at Wildwood. Thereafter, the non-precooled load with its refilled ice bunkers cooled faster. On arrival at Potomac Yards, there was no significant difference in commodity temperatures between the two cars, and on arrival at Greenville Yards, the non-precooled load was about 1 degree cooler than the precooled load.

Cars A and G. These two cars received the same icing and ventilation service, and differed only in loading, car A being the double deck car with bagged load and car G having bags over crates. The difference in average commodity temperatures during the transit period was not great enough to be of practical significance and was no greater than is ofter encountered between similar loads, in cars of similar design.

RIND BREAKDOWN AND DECAY

For the purpose of aiding in the evaluation of the effect upon rind breakdown and decay of the two types of packages and the several refrigeration-in-transit procedures followed, a test package of strictly comparable Pineapple oranges, U. S. No. 1 Grade, size 200, was placed in the top quarter-length position of each car for critical inspection at destination. Because of the difference in lapsed time between loading and first inspection which ranged from four to eleven days, no clear cut deductions can be drawn from the test lots, regarding the effect of temperature in transit on the rind breakdown and decay.

Although the Pineapple variety of orange is susceptible to pitting, a form of rind breakdown, yet it was not visible at the time of packing, nor was it expected to develop in such unusual proportions.

At the first inspection at destination, rind breakdown, Table 4, had developed in from 4.5 percent to 50 percent of the test fruit in the cars inspected within four or five days after loading and from 37.8 percent to 93.4 percent in the test packages in the cars inspected eleven days after loading. A week after the first inspection, rind breakdown had increased greatly in all lots ranging from 51 percent to 88 percent in the former grouping and from 77 percent to 91 percent in the latter. The least amount of rind breakdown at the first inspection was found in the car that had been precooled. There was no decay in any of the test packages at unloading. One week later, total decay ranged from 2 percent to 5.6 percent in the lots from the cars unloaded within a day after arrival at New York whereas from 4.5 percent to 9.6 percent decay was found in the test lots from cars held several days before unloading. In the precooled car, practically all of the decay was stem-end rot; in the others, decay was rather equally divided between green mold and stem-end rot.

The Railroad Perishable Inspection Agency made their usual general inspection of the several cars on arrival at destination three and four days after loading. In general their findings in regard to decay were in harmony with those observed in the test packages removed from the cars and inspected

from four to eleven days after loading. The significant difference between the two inspection reports was in the amount of rind breakdown observed. This condition, like decay, varies from grove to grove and increases with the lapse of time. The test packages were from a source different from those supplying the carlots of fruit and for that reason such differences are not uncommon.

DISCUSSION

The abnormally cold weather encountered by these test cars afforded an unanticipated opportunity to determine the rate of cooling in different parts of the car when vents were open and hatch plugs were out in sub-freezing weather, a situation not often encountered during the first 36-40 hours in the transit period. Accordingly, the vents of one car were opened at Savannah and those of several other cars were opened at Hamlet the following morning while the vents in the remainder were kept closed to destination, as though the outside air temperatures were nearly normal.

This transportation test shows that, even with all vents full open, when outside temperatures were well below freezing during the first day or two in transit, there is not much danger of freezing citrus fruit loaded warm and shipped under existing provisions of the Perishable Protection Tariff. Whereas temperatures in car D dropped to the freezing point in parts of the car, it should be noted that all vents were full open when outside air temperatures were as low as 15°F. If diagonal vents only had been open the temperatures would not have dropped so close to the danger point. It therefore seems that cars may move from Florida points billed "plugs out, vents open" (P.O.V.O.) to Richmond or Potomac Yards, standard ventilation beyond (Rule 385 - combination ventilation - keep vents open to Richmond/Potomac Yards, standard ventilation thereafter). During those rather rare periods when the entire south is experiencing freezing weather such as encountered in this test, and when a car is passing through temperatures well below freezing through North and South Carolina, vents may be kept open until the temperature is down to 25° with standard ventilation beyond those points. (Rule 385, combination ventilation. Vents closed at 25°, open above 25° to ----- (specify station south of northern boundary of North Carolina or Tennessee or east of Mississippi River) standard ventilation thereafter.)

A more realistic schedule for opening and closing vents of cars loaded with Florida oranges, grapefruit and tangerines and billed for ventilation en route would result in better refrigeration in cold to sub-freezing weather than is now the case under standard ventilation, or even under standard refrigeration, which is little if any more effective than is Rule 251 in lowering commodity temperatures during the colder months. Whenever the outside air temperature is considerably below that of the commodity in the car, more rapid cooling may be expected when the vents are open, with or without ice in the bunkers.

In all probability much greater financial losses have resulted from decay developing in cars of Florida fruit when the vents were closed before the fruit had cooled to a safe temperature, than has resulted in freezing damage from leaving the vents open too long.

Continuous ventilation from Savannah to Potomac Yards, when the outside air temperature was well below freezing much of the time, caused the load in a non-fan car to cool much more rapidly than that in re-iced fan cars with vents kept closed.

The precooling of citrus after loading in pre-iced fan cars may not be a necessary step particularly if the car moves within a few hours after loading is completed. The time lag in getting warm fruit to a safe temperature when loaded in a fan car does not appear to be great enough to have much effect on decay in Florida citrus. However, in periods of heavy decay it would be prudent to run the fans until the pickup train comes along.

The decrease in the hourly rate of cooling doubtless resulted largely from the progressively decreased supply of ice in the bunkers. Yet, when the commodity temperature is below 60°, the hourly rate of cooling is slow without the aid of salt, even with bunkers full of ice. If the load is precooled for several hours, the bunkers should be replenished at loading station or the following morning if the car is to receive one re-icing in transit.

The fan car, by cooling the top of the load much more rapidly, always gives a more uniform temperature throughout the load than does the non-fan car receiving the same protective service, even though the average of the top, middle, and bottom of the load is likely to be nearly the same.

It is especially noteworthy that all cars including those iced but once had enough ice in the bunkers on arrival at destination to hold the load at a safe temperature for several days of seasonable weather. The ice bunkers of car D, vented at Savannah, were at least half full on arrival at destination, and this car also had the lowest commodity temperature.

SUMMARY

Oranges in open mesh bags loaded in double deck cars or loaded over two layers of crated fruit cooled about as rapidly during the transit period as did solid loads of crated oranges.

Oranges loaded in fan equipped double deck cars cool more uniformly than those in non-fan cars.

In a carload of 525 crates of oranges with fruit temperature of 81.5°, loaded in a pre-iced fan car and precooled six hours with motor driven Preco fans, the fruit cooled 4.9 degrees during the four hour loading period, and 13.4 degrees during the six hour precooling period. More than half of the total of 18.3 degrees was removed by the end of the first hour of precooling.

Ventilation during this transit period of sub-normal air temperature in the South cooled the load more rapidly than did refilling the ice bunkers and keeping the vents closed to destination, thus indicating that during the cooler months, initial icing followed by ventilation north of Savannah is likely to result in more rapid cooling than by re-icing once and keeping the vents closed to destination.

During periods of nearly normal winter temperatures at destination, the commodity temperatures did not rise in cars that arrived with less than one ton of ice in the bunkers and which were held several days before unloading. These tests indicate that all or only diagonal vents of cars loaded with warm fruit may be left open for considerable periods of time at least during the first day or two after loading - even when outside air temperatures are well below 25° - without danger of freezing the fruit.

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TABLE NO. 1

Florida Oranges — LIST OF TEST CARS — Test 1 - November 1950

Car initial and number	Type	Loading period	Load	Refrigeration service and ventilation
A FDE 9165	Double deck fan-car	2:30 pm to 9:25 pm	7168 5 lb. open mesh bags	Dry car loaded, vents open loading station to Wildwood,Fla. Initially iced 8000 lbs. Item 80, section 1. Vents closed to Hamlet, N.C. Diagonal vents open from Hamlet to Raleigh,N.C., all vents open Raleigh to Potomac Yards,Va., standard ventilation beyond.
B FDE 9032	Double deck non-fan car	10:15 am to 2 20 pm	do	do
C FDE 9052	Double deck non-fan car	10:20 am to 2:45 pm	do	Dry car loaded, vents open loading station to Wildwood, Fla. Initially iced 9600 lbs. Wildwood. Re-iced at Hamlet, N.C. Vents closed from Wildwood to destination.
D FDE 9199	Double deck non-fan car	8:20 am to 2;45 pm	do	Same as Car C, except vents closed Wildwood to Savannah, Ga. only; all vents open Savannah to Hamlet, N.C.; not re-iced at Hamlet. Diagonal vents closed Hamlet to Raleigh; all vents open Raleigh to Potomac Yards, standard ventilation beyond.
E FGE 56339	Standard fan car	4:15 pm to 5:15 pm	525 1 3/5 bu. wirebound crates	Pre-iced, Item 80, section 2. Re-iced at Hamlet, N. C., vents closed to destination.
F FGE 56304	Standard fan car	9:15 am to 1:05 pm	do	Pre-iced, precooled in car, Item 80, section 2; re-iced at Wildwood, Fla. vents closed to destination.
G FGE 57730	Standard fan car	1:35 pm to 7:15 pm	3680 5 lb. open mesh bags over 210 1 3/5 bu. wire-bound crates.	Same as Cars A and B

TABLE NO. 2

Florida Citrus — AVERAGE TEMPERATURES IN TRANSIT — Test 1 - November 1950

Location	Date	A Fan 80-1 2/	B NF 1/ 80-1	C NF 80-1	D NF 80-1	E Fan 80-2 3/	F Fan 80-2	G Fan 80-1
During loading	24	785	731	840	710	775	815	783
After loading		794	767	736	708	746	766	774
End of precooling		---	---	---	---	---	632	---
Wildwood, Fla.	25	757	697	672	680	679	606	714
Baldwin, Fla.	25	662	653	634	637	626	549	632
Savannah, Ga.	25	590	616	599	601	587	511	576
Andrews, S. C.	26	534	570	553	427	555	476	529
Hamlet, N. C.	26	507	553	525	366	537	457	501
Raleigh, N. C.	26	473	475	512	360	500	447	451
Richmond, Va.	26	455	435	491	360	457	435	419
Potomac Yards, Va.	26	426	412	472	352	430	426	392
New York City Area	27	416	428	449	386	402	413	392
New York City Area	28	416	404	417	---	---	---	379
New York City Area	30	380	360	387	---	---	---	367
New York City Area	Dec. 3	387	368	377	---	---	---	382

1/ NF signifies a non-fan car.
2/ 80-1 signifies Item 80, Section 1.
3/ 80-2 signifies Item 80, Section 2.

TABLE NO. 3

Florida Oranges — ICING DATA — Test 1 - November 1950

CAR			A	B	C	D	E	F	G
Icing and bunker inspection	Hour	Date	Partially filled bunker fans "ON" DD	Partially filled bunker non-fan DD	Full bunker non-fan DD	Full bunker non-fan DD	Full bunker fans "ON" FAN	Full bunker fans "ON" FAN	Partially filled bunker fans "ON" FAN
		Nov.	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
Preiced at Wildwood	8:20 P	23	----	----	----	----	9,600	9,600	----
Initially iced at Wildwood	4:30 A	25	8,000	8,000	9,600	9,600	----	----	8,000
Reiced at Wildwood	4:30 A	25	----	----	----	----	----	8,500	----
Ice remaining at Hamlet	6:00 A	26	2,400	4,800	6,000	8,000	1,200	No record	2,400
Reiced at Hamlet	7:05 A	26	----	----	3,600	----	8,400	----	----
Ice remaining at Potomac Yards	11:00 P	26	1,400	4,000	7,200	5,800	7,200	1,900	1,900
Total ice supplied			8,000	8,000	13,200	9,600	18,000	18,100	8,000
Ice remaining on arrival	10:40 P	27	----	----	----	----	6,400	1,000	----
at destination	12:30 P	28	1,200	3,100	6,400	----	----	----	----
	7:05 A	28	----	----	----	5,000	----	----	----
	9:55 A	28	----	----	----	----	----	----	1,000
Ice melted to destination			6,800	4,900	6,800	4,600	11,600	17,100	7,000
Ice remaining at unloading	11:00 P	27	----	----	----	----	6,400	1,000	----
	8:00 P	29	----	----	----	no record	----	----	----
		Dec.							
	9:30 P	3	----	2,400	3,200	----	----	----	----
	1:00 A	4	trace	----	----	----	----	----	----
	3:00 A	4	----	----	----	----	----	----	trace

TABLE NO. 4

DEVELOPMENT OF RIND BREAKDOWN AND DECAY IN

COLOR ADDED U. S. NO. 1 PINEAPPLE ORANGES, SIZE 200

Florida Oranges — Test 1 - November 1950

CAR	Time interval 1/	First inspection				+ 1 week at room temperature			
		RB 2/	SER	GM	Total DK	RB 2/	SER 3/	GM 3/	Total DK 3/
	Days	Percent				Percent			
A	11	37.8	0	0	0	76.7	5.6	4.0	9.6
B	11	88.4	0	0	0	90.9	2.5	2.0	4.5
C	11	93.6	0	0	0	85.8	4.0	5.6	9.6
D	5	50.0	0	0	0	88.3	2.5	1.5	4.0
E	4	13.7	0	0	0	47.5	1.0	1.0	2.0
F	4	4.5	0	0	0	50.5	5.1	0.5	5.6
G	11	47.0	0	0	0	82.2	3.0	2.5	5.6

1/ Time interval between loading and first inspection at destination
2/ Includes aging and pitting of commercial importance
3/ Cumulatively

KEY:

RB signifies Rind Breakdown
SER signifies Stem End Rot
GM signifies Green Mold
DK signifies Decay

Table 5 — TEMPERATURES IN TRANSIT — Nov., 1950-A

Oranges

7168 5-lb. open-mesh bags — Double-deck - FDE 9165, Fans On — Billing Weight - 40141

Bunkers dry, Item 80, Section 1. VO Leesburg to Wildwood; initially iced Wildwood; VC Wildwood to Hamlet; diagonal vents open Hamlet to Raleigh; all vents open Raleigh to Potomac Yards; standard ventilation beyond.

Place	Date Nov.	Time	OST	Top Air	Bot Air	BB CL	BQ CL	BD CL	MB CL	MQ CL	MD CL	TB CL	TQ CL	TD CL	XQ CL	Bot Avg	Mid Avg	Top Avg	Grand Avg
Leesburg, Fla.	24	9:25P	58	758	669	794	742	727	815	779	824	827	815	823	772	754	806	822	794
Wildwood, Fla.	25	4:05A	33	738	404	714	702	717	785	769	784	797	775	773	762	711	779	782	757
Initially iced 8000 lbs., Wildwood, 4:30A																			
Baldwin, Fla.	25	10:15A	28	578	394	654	672	672	685	689	694	637	675	583	687	666	689	632	662
Savannah, Geo.	25	3:45P	24	488	404	614	622	607	605	609	614	557	565	513	622	614	609	545	590
Andrews, S. C.	26	1:00A	19	468	394	554	562	537	545	559	544	517	515	473	512	551	549	502	534
Hamlet, N. C.	26	5:45A	15	438	364	534	532	507	525	529	514	477	505	443	532	524	523	475	507
Raleigh, N. C.	26	10:00A	27	368	404	514	502	477	495	509	484	477	445	353	482	498	496	425	473
Richmond, Va.	26	3:30P	32	363	434	484	472	427	460	489	444	477	475	363	442	461	464	438	455
Potomac Yards, Va.	26	11:10P	28	358	374	464	432	397	435	459	404	467	435	343	442	431	433	415	426
Greenville, N. J.	27	1:00P	38	378	394	434	422	387	425	429	384	417	465	383	452	414	413	422	416
Harlem River, N. Y.	28	12:35P	37	398	349	414	402	387	425	429	394	427	485	383	452	401	416	432	416
Harlem River, N. Y.	30	2:00P	40	358	344	354	342	367	375	389	384	387	455	363	432	354	383	402	380
Harlem River, N. Y.	Dec. 3	3:00P	52	458	344	354	352	357	375	389	384	387	485	403	422	354	383	425	387

Notes:

VO - vents open
VC - vents closed
OST - outside temperature
BB - bottom bunker
CL - centerline
BQ - bottom quarterlength
BD - bottom doorway
MB - middle bunker
MQ - middle quarterlength
MD - middle doorway
TB - top bunker
TQ - top quarterlength
TD - top doorway
XQ - top bag lower deck, not included in averages

Table 6 — TEMPERATURES IN TRANSIT — Nov., 1950-B

7168 5-lb. open-mesh bags — Double-deck - FDE 9032, No Fan — Oranges — Billing Weight - 40141

Bunkers dry, Item 80, Section 1. VO Leesburg to Wildwood; intially iced Wildwood; VC Wildwood to Hamlet; diagonal vents open Hamlet to Raleigh; all vents open Raleigh to Potomac Yards; standard ventilation beyond.

Place	Date Nov.	Time	OST	Top Air	Bot Air	BB CL	BQ CL	BD CL	MB CL	MQ CL	MD CL	TB CL	TQ CL	TD CL	XQ CL	Bot Avg	Mid Avg	Top Avg	Grand Avg
Leesburg, Fla.	24	7:00P	65	778	677	717	786	724	807	766	737	783	830	754	722	742	770	789	767
Wildwood, Fla.	25	4:05A	33	698	367	617	651	654	697	726	767	708	710	744	732	641	730	721	697
				Initially iced 8000 lbs., Wildwood, 4:30A															
Baldwin, Fla.	25	10:15A	28	708	367	527	516	574	657	691	727	723	725	734	682	539	692	727	653
Savannah, Ga.	25	3:45P	24	678	357	477	496	514	622	656	687	698	700	694	632	496	655	697	616
Andrews, S. C.	26	1:00A	19	638	417	437	451	454	577	606	637	658	670	644	572	447	607	657	570
Hamlet, N. C.	26	5:45A	15	618	337	417	431	434	567	586	617	648	650	624	552	427	590	641	553
Raleigh, N. C.	26	10:00A	27	478	267	347	371	404	487	526	587	558	480	514	492	374	533	517	475
Richmond, Va.	26	3:30P	32	468	297	327	341	364	407	466	537	528	470	474	432	344	470	491	435
Potomac Yards, Va.	26	11:10P	28	438	337	327	331	344	377	436	497	488	460	444	392	334	437	464	412
Greenville, N. J.	27	1:10P	38	478	337	347	361	354	427	426	467	498	500	474	402	354	440	491	428
Harlem River, N. Y.	28	12:35P	37	388	337	357	361	354	407	416	427	438	440	434	382	357	417	437	404
Harlem River, N. Y.	30	2:00P	40	358	327	337	341	334	357	366	377	378	380	374	352	337	367	377	360
Harlem River, N. Y.	Dec. 3	3:00P	52	468	337	347	351	334	367	366	367	408	---	404	352	344	367	406	368

Table 7 — TEMPERATURES IN TRANSIT — Nov., 1950-C

7168 5-lb. open-mesh bags — Double-deck - FDE 9052, No Fan — Oranges — Billing Weight - 40141

Bunkers dry, Item 80, Section 1. VO Leesburg to Wildwood; initially iced Wildwood; reiced to capacity Hamlet. Vents closed Wildwood to destination

Place	Date Nov.	Time	OST	Top Air	Bot Air	BB CL	BQ CL	BD CL	MB CL	MQ CL	MD CL	TB CL	TQ CL	TD CL	XQ CL	Bot Avg	Mid Avg	Top Avg	Grand Avg
Zellwood, Fla.	24	3:00P	61	757	647	688	757	737	757	788	677	778	737	708	738	727	741	741	736
Wildwood, Fla.	25	4:05A	33	687	327	528	687	657	657	748	727	688	687	---	708	624	711	688	672
Initially iced 9600 lbs., Wildwood, 4:30A																			
Baldwin, Fla.	25	10:15A	28	687	337	403	607	562	617	718	707	698	707	688	683	524	681	698	634
Savannah, Ga.	25	3:45P	24	667	337	368	547	497	577	678	677	688	687	668	648	471	644	681	599
Andrews, S. C.	26	1:00A	19	637	327	348	477	427	527	628	627	658	657	628	588	417	594	648	553
Hamlet, N. C.	26	5:45A	15	627	327	348	457	407	517	608	607	648	---	608	568	404	577	628	525
Reiced, Hamlet, 7:00A																			
Raleigh, N. C.	26	10:00A	27	587	317	328	437	387	487	578	577	618	617	578	528	384	547	604	512
Richmond, Va.	26	3:30P	32	577	317	328	417	367	467	553	537	588	592	568	488	371	519	583	491
Potomac Yards, Va.	26	11:10P	28	557	317	328	397	357	437	528	497	568	577	558	458	361	487	568	472
Greenville, N. J.	27	1:10P	38	517	327	338	387	357	417	488	467	538	537	508	448	361	457	528	449
Harlem River, N. Y.	28	12:35P	37	477	327	328	372	347	397	448	417	488	487	468	413	349	421	481	417
Harlem River, N. Y.	30	2:00P	40	427	327	328	367	347	377	408	387	428	437	408	388	347	391	424	387
Harlem River, N. Y.	Dec. 3	3:00P	52	417	327	328	357	347	367	388	387	418	417	388	378	344	381	408	377

Table 8 — TEMPERATURES IN TRANSIT — Nov., 1950-D

7168 5-lb. open-mesh bags — Double-deck - FDE 9199, No Fan — Oranges — Billing Weight - 40141

Bunkers dry, Item 80, Section 1. VO Zellwood to Wildwood; initially iced Wildwood; VC Wildwood to Savannah; VO Savannah to Hamlet; diagonal vents closed Hamlet to Raleigh; all vents open Raleigh to Potomac Yards; standard ventilation beyond.

Place	Date Nov.	Time	OST	Top Air	Bot Air	BB CL	BQ CL	BD CL	MB CL	MQ CL	MD CL	TB CL	TQ CL	TD CL	XQ CL	Bot Avg	Mid Avg	Top Avg	Grand Avg
Zellwood, Fla.	24	3:00P	61	668	689	687	728	706	719	758	708	707	687	676	---	707	728	690	708
Wildwood, Fla.	25	4:05A	33	658	479	597	638	676	709	768	---	657	677	716	---	637	739	683	680
Initially iced 9600 lbs., Wildwood, 4:30A																			
Baldwin, Fla.	25	10:15A	28	698	349	487	518	596	659	738	---	707	697	696	---	534	699	700	637
Savannah, Ga.	25	3:45P	24	658	339	427	458	526	629	708	---	697	687	676	---	470	669	687	601
Andrews, S. C.	26	1:00A	19	458	249	307	338	426	519	628	---	377	367	456	---	357	574	400	427
Hamlet, N. C.	26	5:45A	15	388	219	277	278	376	439	578	---	307	297	376	---	310	509	327	366
Raleigh, N. C.	26	10:00A	27	398	209	277	298	336	409	538	---	307	317	396	---	304	474	340	360
Richmond, Va.	26	3:30P	32	398	259	277	298	331	364	498	---	352	357	406	---	302	431	372	360
Potomac Yards, Va.	26	11:10P	28	388	279	287	298	296	349	458	---	367	347	416	---	294	404	377	352
Waverly, N. J.	27	9:30P	38	438	329	297	---	296	379	438	---	427	427	436	---	297	409	430	386

Table 9 TEMPERATURES IN TRANSIT Nov., 1950-E

Oranges

525 boxes FGE 56339, Fans On Billing Weight - 48825

Preiced, Item 80, Section 2; reiced Hamlet; VC to destination.

Place	Date Nov.	Time	OST	Top Air	Bot Air	BB CL	BQ CL	BD CL	MB CL	MQ CL	MD CL	TB CL	TQ CL	TD CL	TXQ CL	Bot Avg	Mid Avg	Top Avg	Grand Avg
Preiced 9600 lbs., Wildwood, 8:20P																			
Winter Garden, Fla.	24	6:30P	67	752	395	669	700	694	740	784	756	790	812	769	819	688	760	790	746
Wildwood, Fla.	25	4:05A	33	662	415	549	640	624	670	744	736	740	722	689	789	604	717	717	679
Baldwin, Fla.	25	10:15A	28	562	425	579	650	624	610	674	676	640	612	569	699	618	653	607	626
Savannah, Ga.	25	3:45P	24	522	445	569	640	604	590	614	626	570	542	529	609	604	610	547	587
Andrews, S. C.	26	1:00A	19	502	435	539	590	564	560	584	586	540	522	509	569	564	577	524	555
Hamlet, N. C.	26	5:45A	15	497	415	539	580	554	550	554	546	520	502	489	539	558	550	504	537
Reiced, Hamlet, 7:00A																			
Raleigh, N. C.	26	10:00A	27	412	365	509	550	524	520	514	526	500	442	419	509	528	520	454	500
Richmond, Va.	26	3:30P	32	402	355	474	500	484	490	464	471	450	392	389	449	486	475	410	457
Potomac Yards, Va.	26	11:10P	28	382	335	429	470	444	460	444	446	420	382	379	429	448	450	394	430
New York, New York	27	11:00P	38	392	335	389	420	404	420	414	416	400	382	369	399	404	417	384	402

Note:
TXQ - center fruit of top quarterlength not included in averages

Table 10

TEMPERATURES DURING PRECOOLING

525 Boxes Oranges
Billing Weight - 48825

WITH ICE AND PORTABLE ELECTRIC MOTORS AND PRECO FANS
ON FGE 56304

Nov. 24, 1950-F
Tavares, Florida

Time	OST	Top Air	Bot Air	BB CL	BQ CL	BD CL	MB CL	MQ CL	MD CL	TB CL	TQ CL	TD CL	TXQ CL	Bot Avg	Mid Avg	Top Avg	Grand Avg
1:15P	71	775	383	664	675	744	767	790	835	803	800	817	807	694	797	807	766
2:15P	72	495	703	659	705	729	737	755	770	773	665	697	742	698	754	712	721
3:15P	67	525	698	664	715	714	717	730	730	748	610	637	692	698	725	665	696
4:15P	67	525	693	674	720	699	697	705	695	718	580	607	652	698	699	635	677
5:15P	65	530	683	679	715	684	682	680	675	688	560	587	622	693	679	612	661
6:15P	65	535	673	679	710	664	667	660	650	663	550	572	597	684	659	595	646
7:15P	62	530	663	679	700	649	647	640	630	643	540	557	577	676	639	580	632

Table 11 — TEMPERATURES IN TRANSIT — Nov., 1950-F

525 boxes — FGE 56304, Fans On — Oranges

Billing Weight - 48825

Preiced, Item 80, Section 2. Precooled in car; reiced in Wildwood; VC to destination.

Place	Date Nov.	Time	OST	Top Air	Bot Air	BB CL	BQ CL	BD CL	MB CL	MQ CL	MD CL	TB CL	TQ CL	TD CL	TXQ CL	Bot Ave	Mid Ave	Top Ave	Grand Ave
Preiced 9600 lbs., Wildwood, 8:20P																			
Tavares, Fla.	24	1:15P	71	775	383	664	675	749	767	790	835	803	800	817	807	696	797	807	766
Precooled 6 hours in car																			
Tavares, Fla.	24	7:15P	62	530	663	679	700	649	647	640	630	643	540	557	577	676	639	580	632
Wildwood, Fla.	25	4:05A	33	570	353	549	605	594	652	645	650	628	560	572	587	583	649	587	606
Reiced, Wildwood, 4:30A																			
Baldwin, Fla.	25	10:15A	28	470	353	539	605	564	592	605	555	563	450	472	547	569	584	495	549
Savannah, Ga.	25	3:45P	24	410	373	539	585	524	542	545	490	528	410	432	477	549	526	457	511
Andrews, S. C.	26	1:00A	19	400	353	499	545	474	512	505	450	488	400	412	447	506	489	433	476
Hamlet, N. C.	26	5:45A	15	390	343	499	525	454	492	475	430	458	390	392	417	493	466	413	457
Raleigh, N. C.	26	10:00A	27	370	363	479	515	444	472	465	420	448	390	392	407	479	452	410	447
Richmond, Va.	26	3:30P	32	380	353	469	485	434	457	445	410	428	390	397	397	463	437	405	435
Potomac Yards, Va.	26	11:10P	28	380	353	449	465	424	452	435	410	428	380	392	397	446	432	400	426
New York, New York	27	11:00P	38	390	333	409	425	414	432	425	410	418	390	392	397	416	422	400	413

Table 12
3680 5-lb. open-mesh bags
Over 210 boxes

TEMPERATURES IN TRANSIT

FGE 57730, Fans On

Nov., 1950-G
Oranges
Billing Weight - 40138

Bunkers dry, Item 80, Section 1.VO Leesburg to Wildwood; Initially iced Wildwood; VC Wildwood to Hamlet; diagonal vents open Hamlet to Raleigh; all vents open Raleigh to Potomac Yards; standard ventilation beyond.

Place	Date Nov.	Time	OST	Top Air	Bot Air	BB CL	BQ CL	BD CL	MB CL	MQ CL	MD CL	TB CL	TQ CL	TD CL	TD ES	Bot Avg	Mid Avg	Top Avg	Grand Avg
Leesburg, Fla.	24	7:30P	65	757	682	722	776	789	812	818	---	787	760	730	733	762	815	759	774
Wildwood, Fla.	25	4:05A	33	717	392	582	701	709	742	788	---	732	740	720	723	664	765	731	714
Initially iced, Wildwood, 4:30A 8000 lbs.																			
Baldwin, Fla.	25	10:15A	28	557	427	632	691	669	692	688	---	572	560	550	543	664	690	561	632
Savannah, Ga.	25	3:45P	24	477	467	612	651	619	637	588	---	512	500	490	483	627	613	501	576
Andrews, S. C.	26	1:00A	19	467	422	562	581	569	572	528	---	482	480	460	463	571	550	474	529
Hamlet, N. C.	26	5:45A	15	437	382	532	551	529	542	488	---	462	460	440	433	537	515	454	501
Raleigh, N. C.	26	10:00A	27	347	372	502	521	489	512	438	---	422	360	360	368	504	475	381	451
Richmond, Va.	26	3:30P	32	367	407	447	471	439	462	388	---	402	370	370	373	452	425	381	419
Potomac Yards, Va.	26	11:10P	28	367	342	402	431	409	432	378	---	362	360	360	363	414	405	361	392
Greenville, N. J.	27	1:10P	38	377	382	402	411	399	402	378	---	382	380	380	373	404	390	381	392
Harlem River, N. Y.	28	12:35P	37	367	342	362	401	389	402	368	---	372	370	370	373	384	385	371	379
Harlem River, N. Y.	30	2:00P	40	377	342	332	371	359	382	388	---	362	370	370	363	354	385	367	367
Harlem River, N. Y.	Dec. 3	3:00P	52	467	362	362	371	359	382	378	---	392	410	400	403	364	380	401	382

Note:
TDES - top door east side, not included in averages

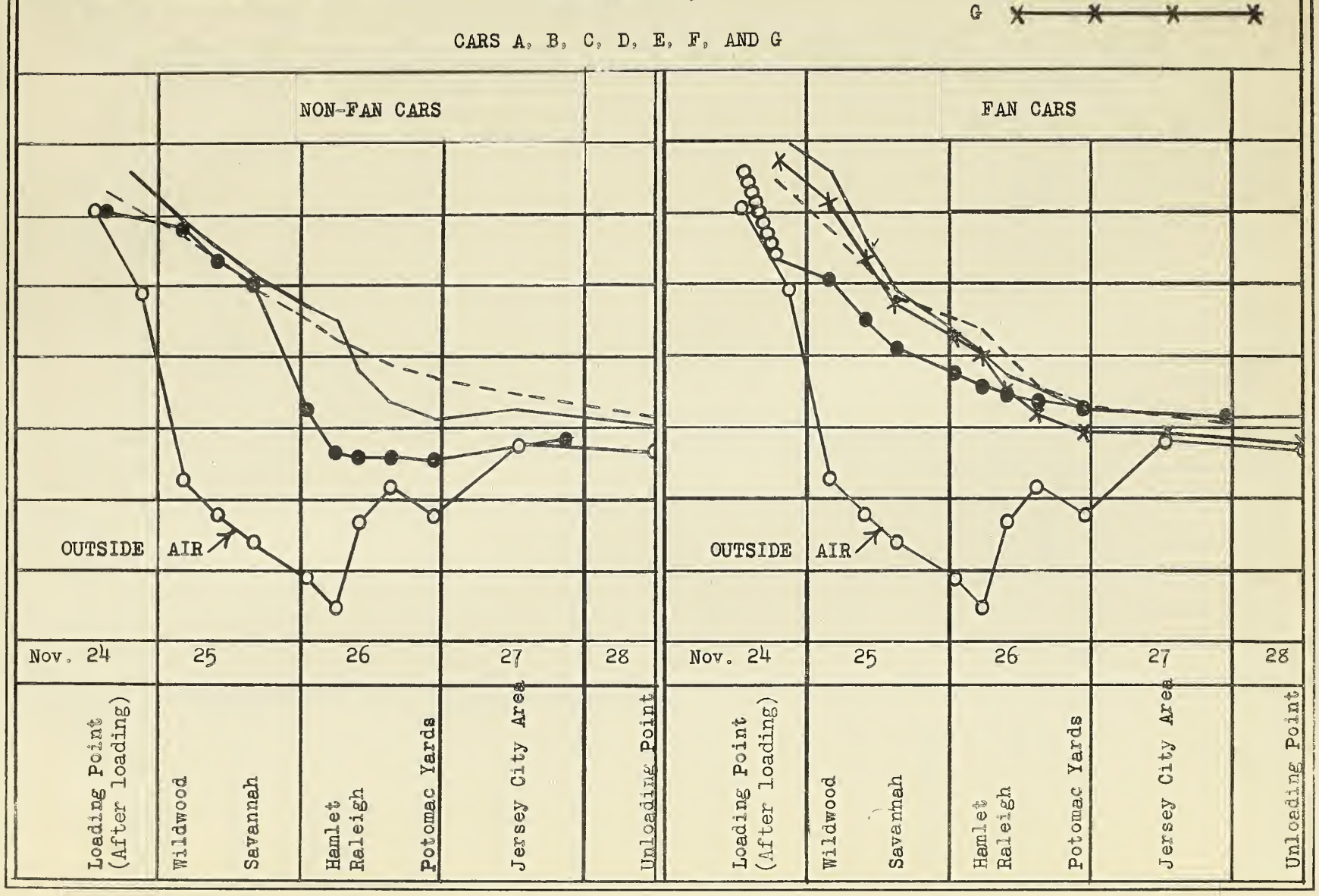
Figure 1

Average Commodity Temperature
During Transit Period
November, 1950

CARS A, B, C, D, E, F, AND G

AVERAGE FRUIT TEMPERATURE
B
C
D

AVERAGE FRUIT TEMPERATURE
A
E
F Precooling
F
G



FRUIT TEMPERATURES
Avg. Top
Avg. Mid
Avg. Bot

Figure 2

Vents Open Leesburg to Wildwood.
Initially Iced Wildwood.
Vents Closed Wildwood to Hamlet.
Diagonal vents open Hamlet to Raleigh.
All vents open Raleigh to Potomac Yards.
Standard ventilation Potomac Yards to destination.

CAR A ORANGES (Nov. 1950)
ITEM 80, SECTION 1
7168 5-LB. OPEN-MESH BAGS
DOUBLE-DECK CAR, FANS ON

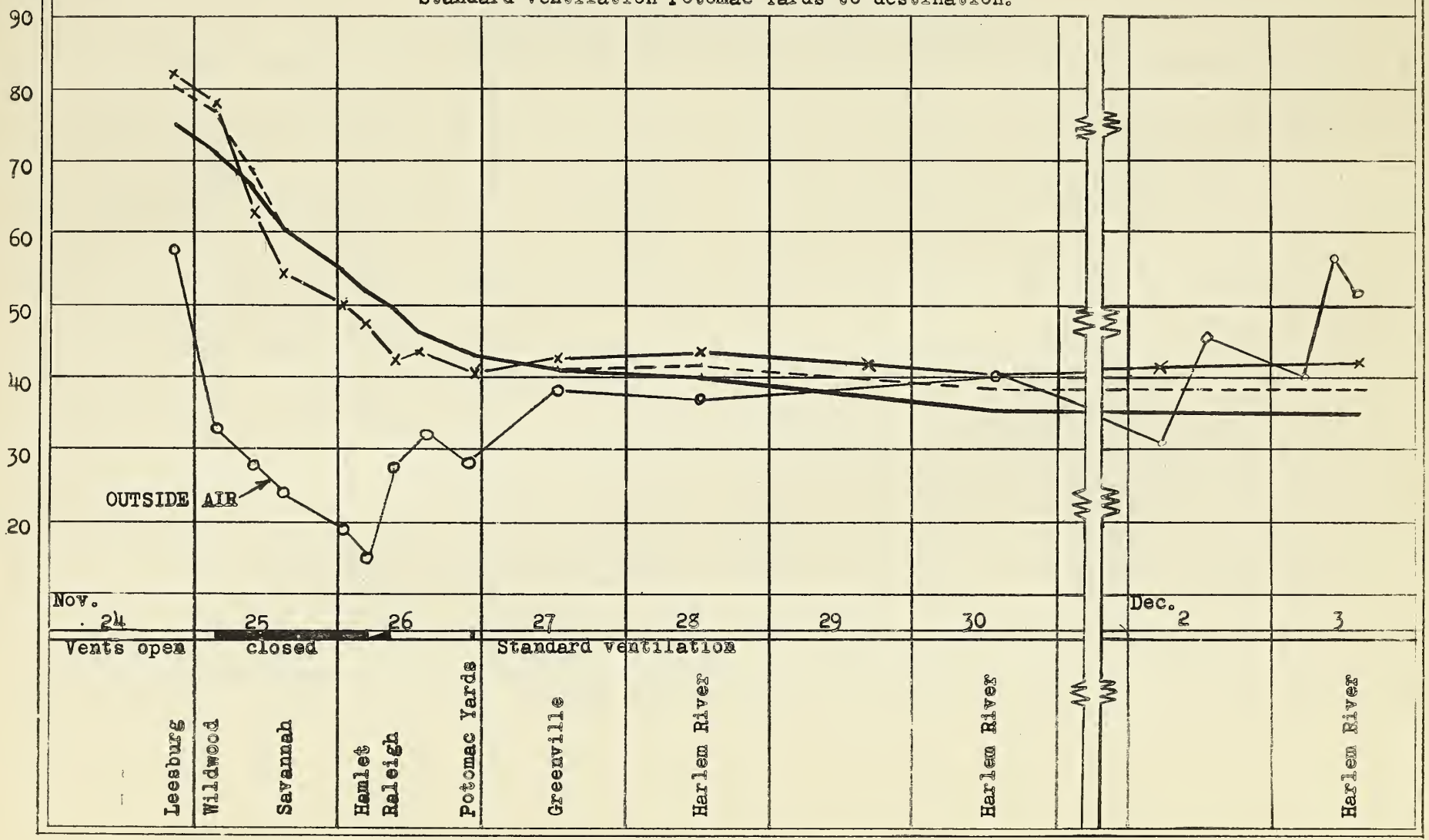


Figure 3

FRUIT TEMPERATURES
Avg. Top ×—×—×—
Avg. Mid – – – – –
Avg. Top ———

Vents Open Leesburg to Wildwood
Initially iced Wildwood
Vents Closed Wildwood to Hamlet
Diagonal vents open Hamlet to Raleigh.
All vents open Raleigh to Potomac Yards.
Standard ventilation Potomac Yards to destination.

CAR B ORANGES (Nov. 1950)
ITEM 80, SECTION 1
7168 5-LB. OPEN-MESH BAGS
DOUBLE-DECK CAR, NO FANS

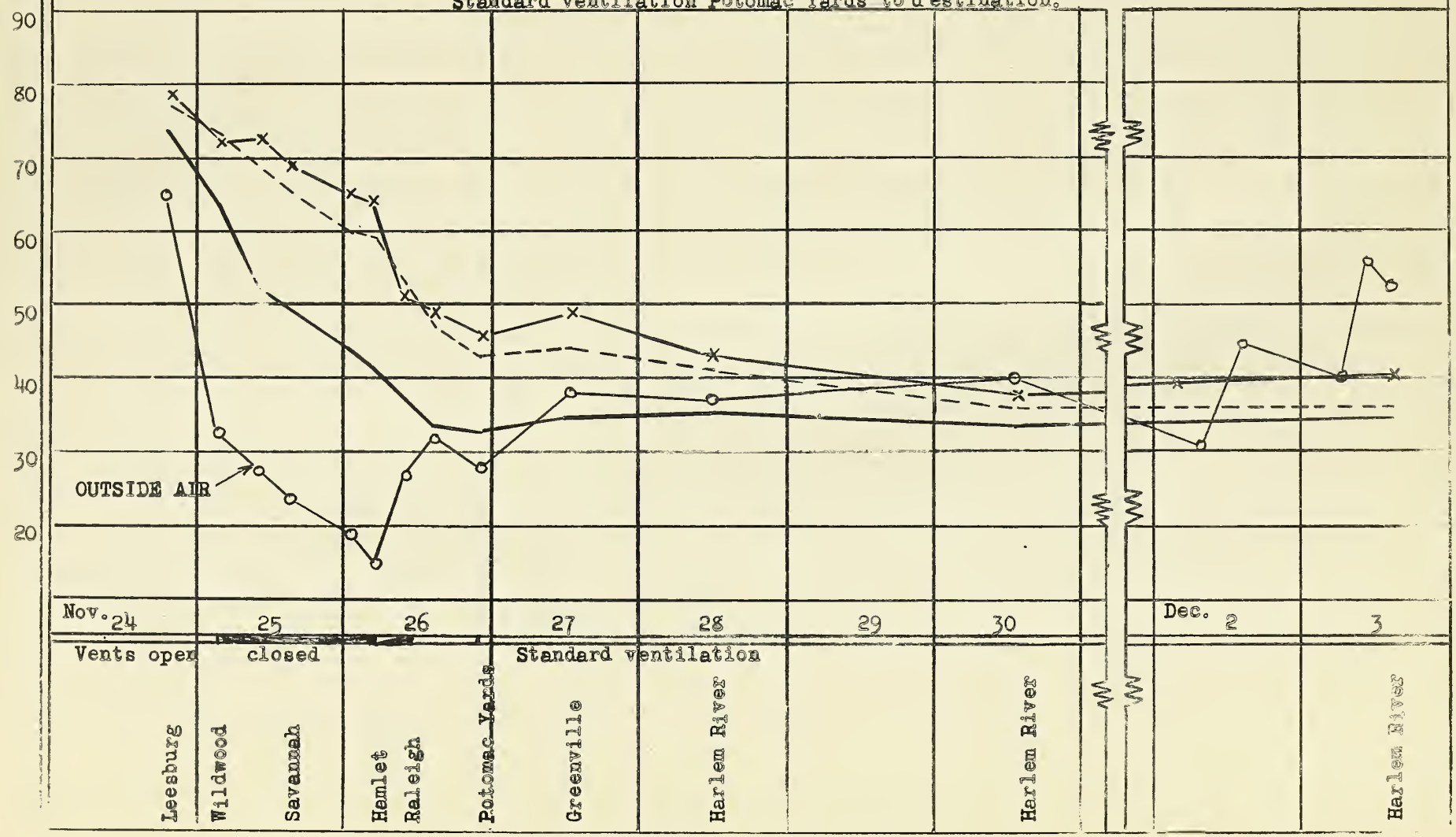


Figure 4

FRUIT TEMPERATURES
Avg. Top
Avg. Mid
Avg. Bot

CAR C ORANGES (Nov. 1950)
ITEM 60, SECTION 1, REICED HAMLET
7168 5-LB. OPEN-MESH BAGS
DOUBLE-DECK CAR, NO FANS

Initially iced at Wildwood; reiced at Hamlet
Vents open to Wildwood; closed to destination

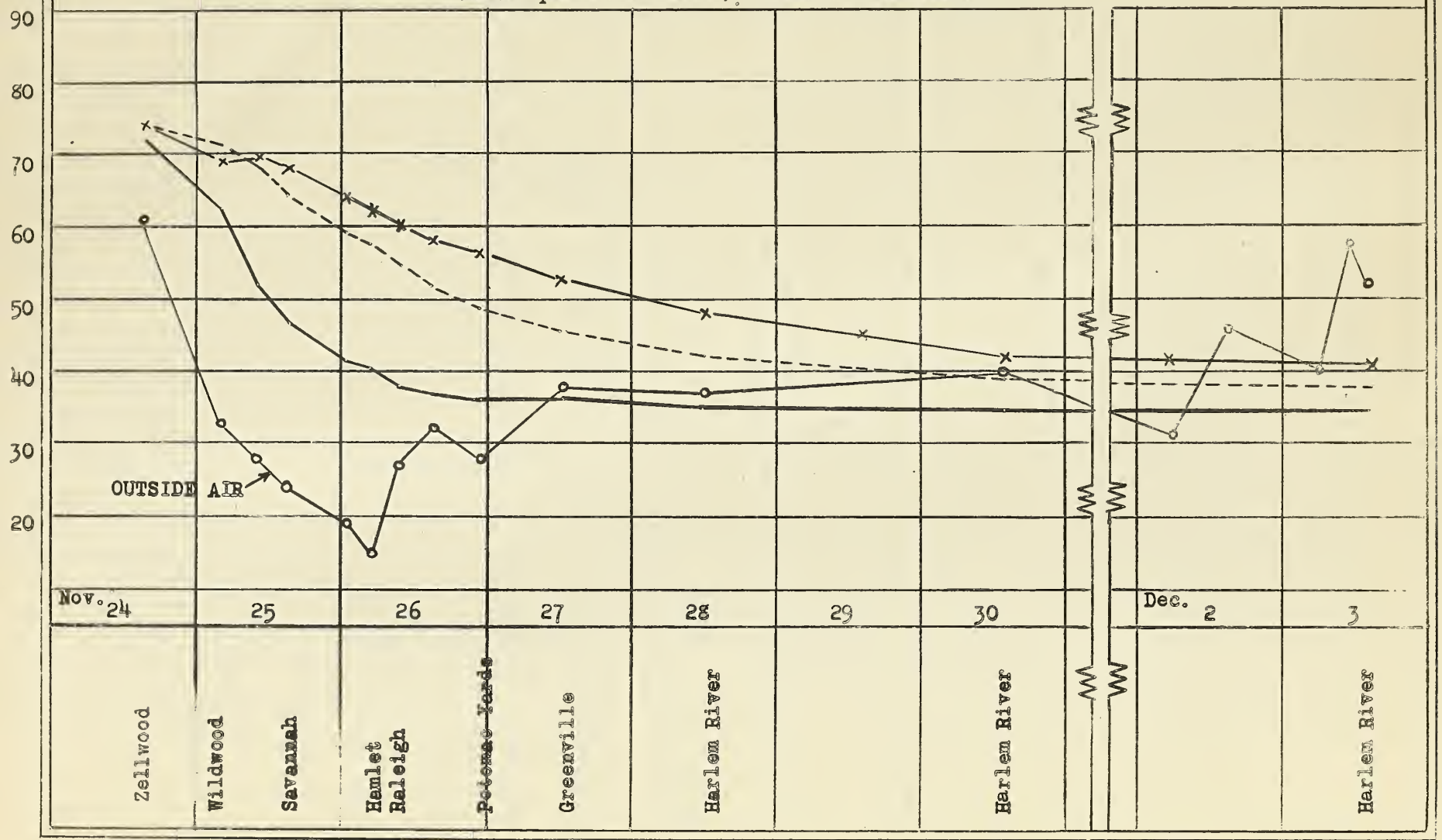


Figure 5

FRUIT TEMPERATURES
Avg. Top
Avg. Mid
Avg. Bot

Vents Open Zellwood to Wildwood
Initially iced Wildwood
Vents closed Wildwood to Savannah
All vents open Savannah to Hamlet.
Diagonal vents closed Hamlet to Raleigh
All vents open Raleigh to Potomac Yards.
Standard ventilation Potomac Yards to destination.

CAR D ORANGES (Nov. 1950)
ITEM 80, SECTION 1
7168 5-LB. OPEN-MESH BAGS
DOUBLE-DECK CAR, NO FANS

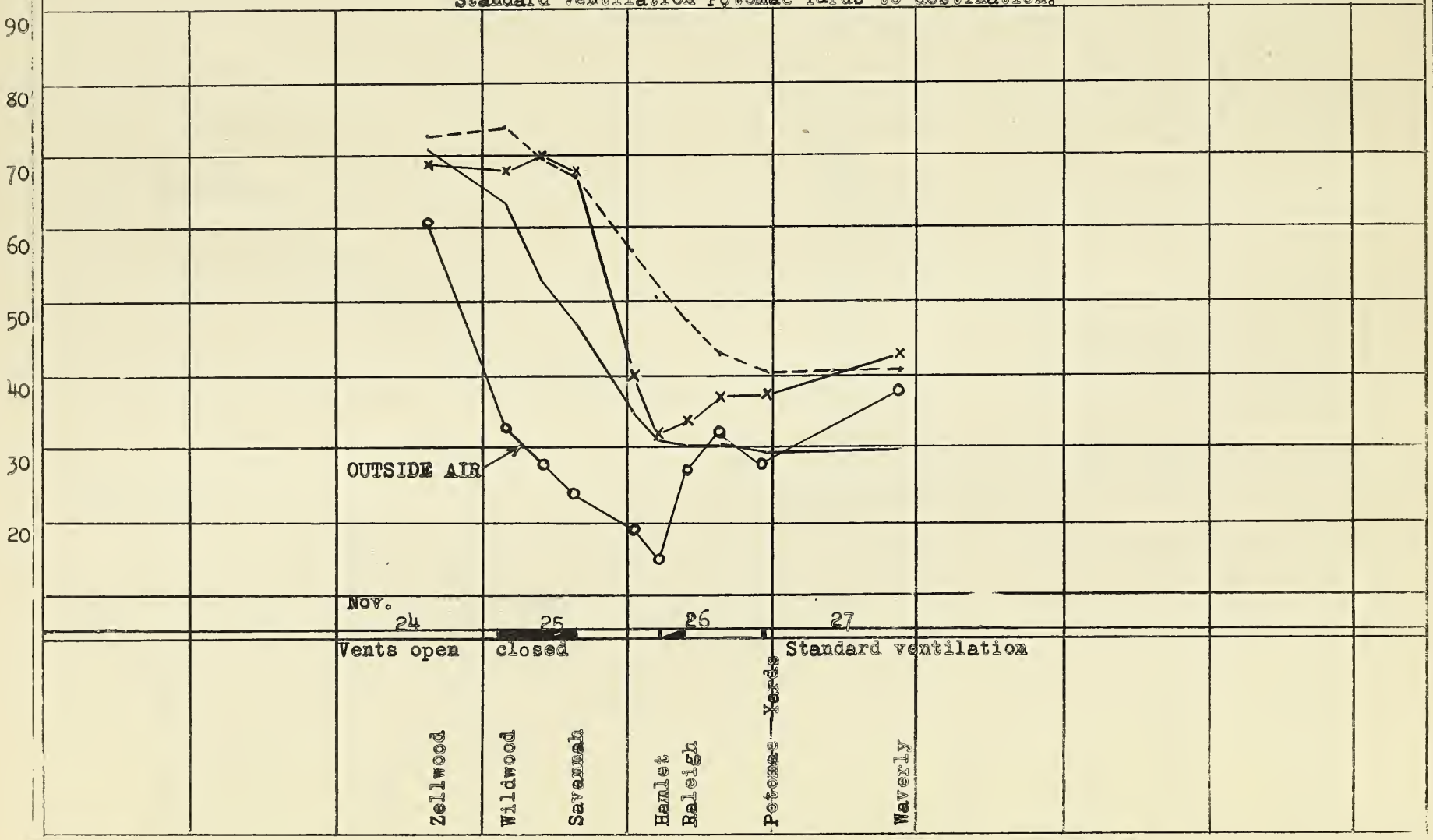


Figure 6

CAR E ORANGES (Nov. 1950) 525 BOXES
ITEM 80, SECTION 2, PREICED, FAN CAR
REICED AT HAMLET
VENTS CLOSED TO DESTINATION

FRUIT TEMPERATURES
Avg. Top x——x——x——
Avg. Mid - - - - - - - -
Avg. Bot ————————

CAR F ORANGES (Nov. 1950) 525 BOXES
ITEM 80, SECTION 2, PREICED, FAN CAR
PRECOOLED IN CAR 6 HOURS
REICED AT WILDWOOD
VENTS CLOSED TO DESTINATION

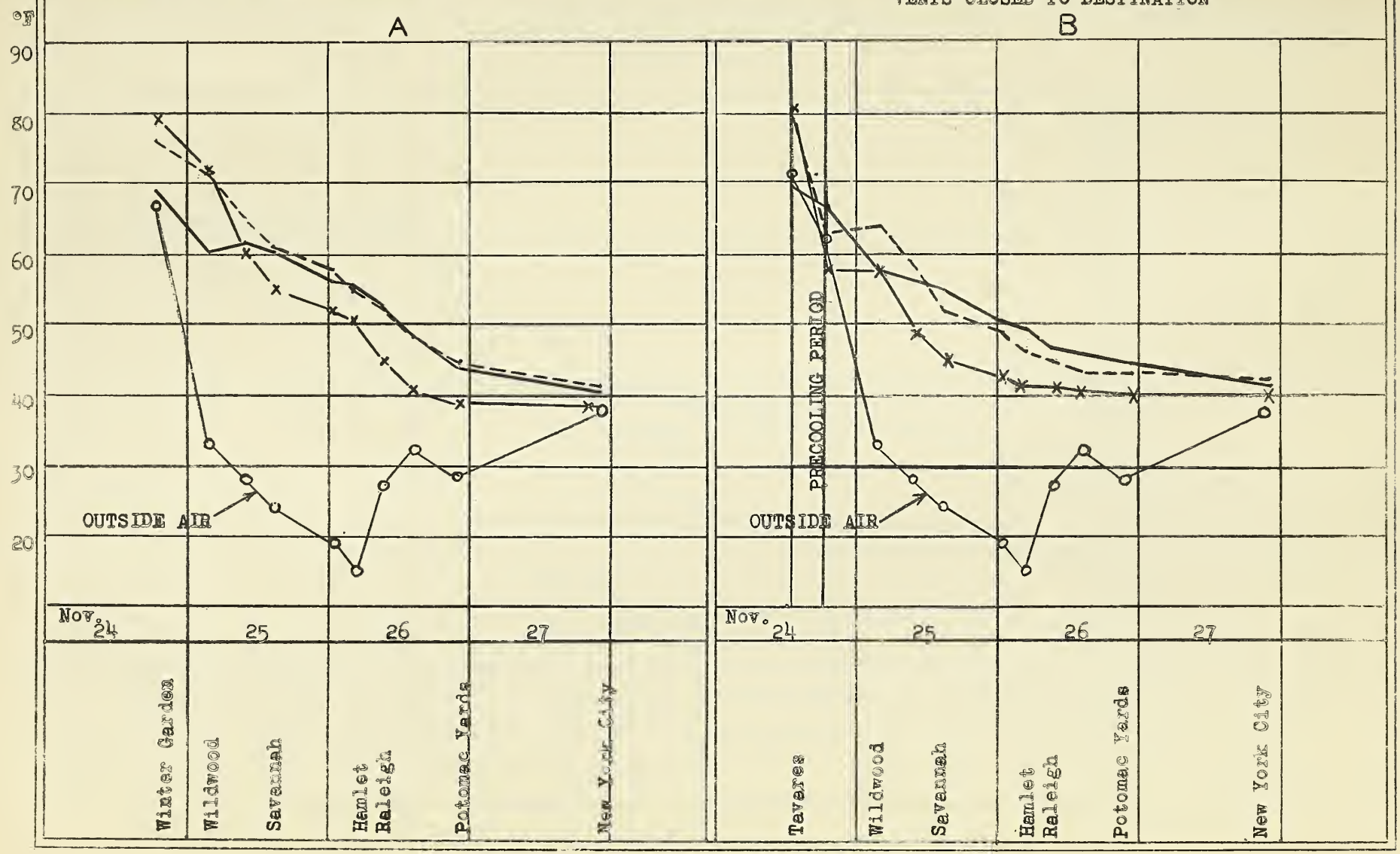


Figure 7

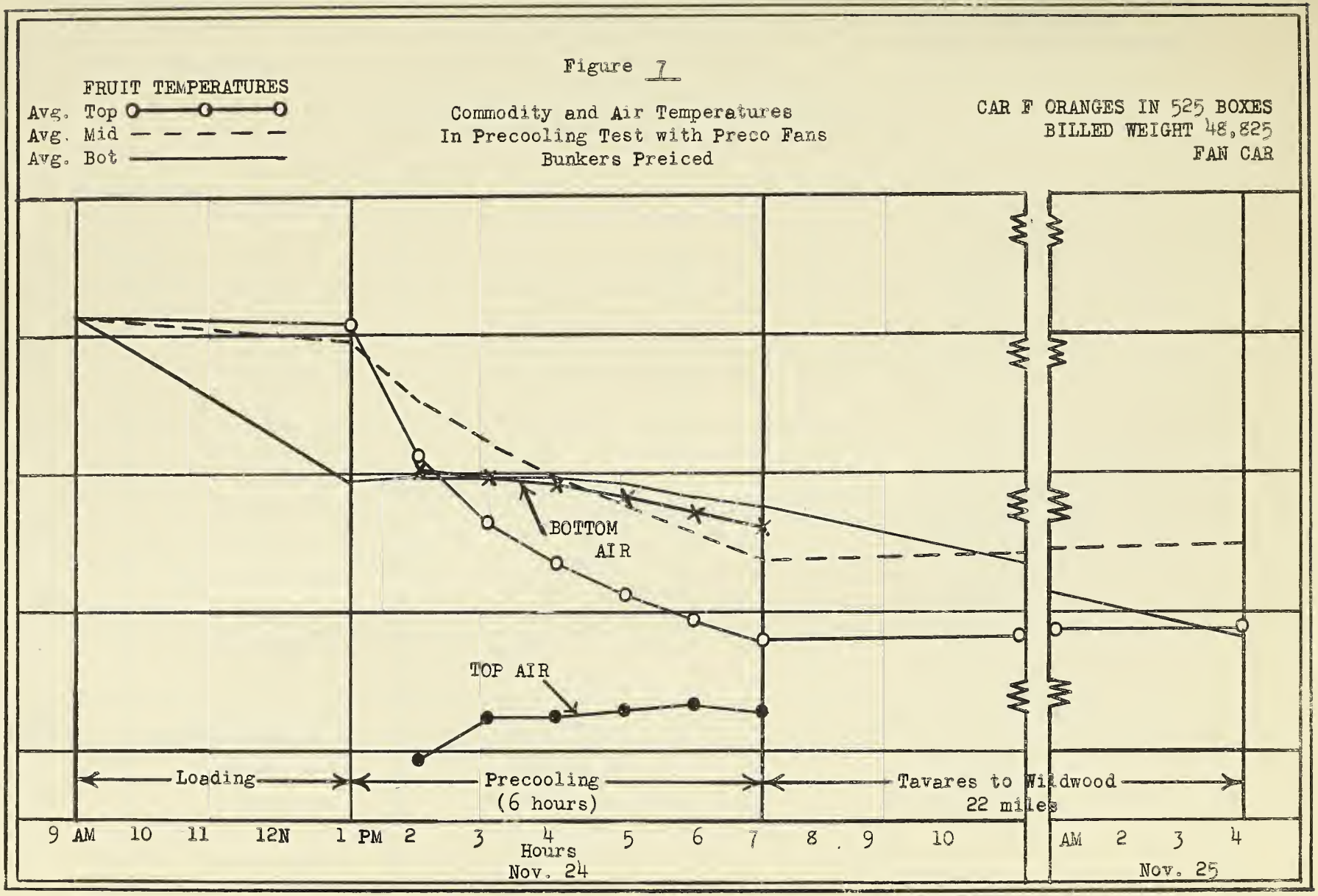
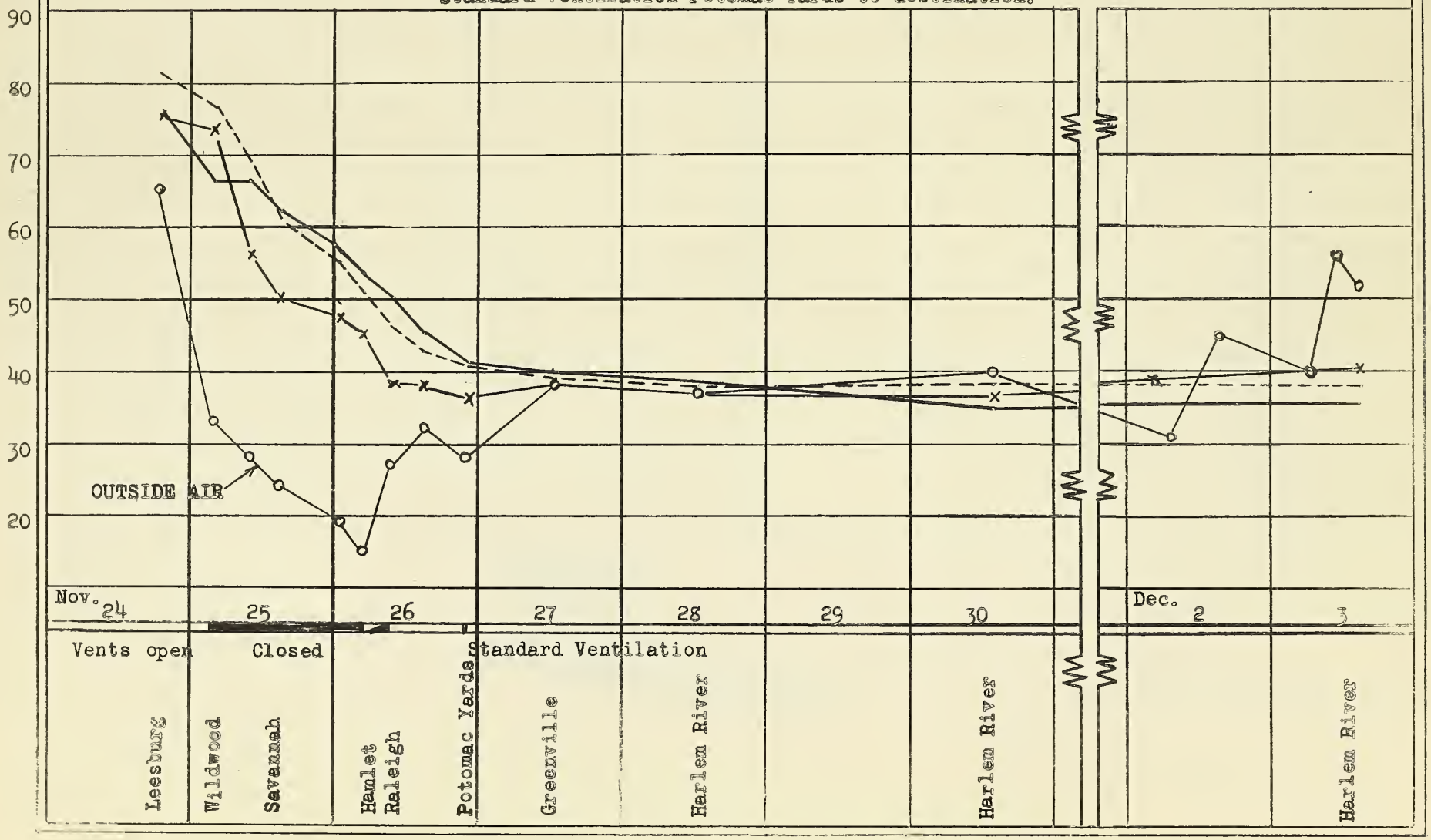

FRUIT TEMPERATURES
Avg. Top
Avg. Mid
Avg. Bot
Commodity and Air Temperatures
In Precooling Test with Preco Fans
Bunkers Preiced
CAR F ORANGES IN 525 BOXES
BILLED WEIGHT 48,825
FAN CAR
°F
90
80
70
60
50
BOTTOM AIR
TOP AIR
Loading
Precooling (6 hours)
Tavares to Wildwood 22 miles
9 AM 10 11 12N 1 PM 2 3 4 5 6 7 8 9 10
Hours Nov. 24
AM 2 3 4
Nov. 25

Figure 8

FRUIT TEMPERATURES
Avg. Top
Avg. Mid
Avg. Bot

Vents open Leesburg to Wildwood
Initially iced Wildwood
Vents closed Wildwood to Hamlet
Diagonal vents open Hamlet to Raleigh.
All vents open Raleigh to Potomac Yards.
Standard ventilation Potomac Yards to destination.

CAR G ORANGES (Nov. 1950)
ITEM 80, SECTION 1
3680 5-LB OPEN-MESH BAGS
OVER 210 BOXES